2023-24

B. TECH. (ODD SEMESTER) EXAMINATION
MECHANICAL ENGINEERING
MACHINE DESIGN II (MEC3110)

Maximum Marks: 60 **Credits: 04** **Duration: Two Hours**

Answer all the questions.
Assume suitable data if missing. The use of data sheets is permitted.
Notations used have their usual meaning.

Q.No.	Question	M.M.	CO
1.(a)	(i) The distance from the joint root to the toe of the weld is called (a) Leg (b) Face (c) Effective throat (d) Actual throat (ii) In a self-locking brake, the applied force required to engage the brake is (a) Zero (b) Minimum (c) Maximum (d) Average (iii) In a disc brake, torque is linearly proportional to the actuating force. (a) Proportional to its cube (b) Yes (c) Independent of force (d) Proportional to its square	[01×3]	CO1
1 (b)	(i) A 50 mm diameter solid shaft is welded to a flat plate by 10mm fillet weld as seen in Fig. 1. Find the maximum torque that the welded joint can sustain if the maximum shear stress intensity in the weld material is not to exceed 80MPa. (ii) What are the limitations and applications of a centrifugal clutch?	[02×2]	CO1
1 (c)	A single block brake with a torque capacity of 15 N-m is shown in Fig. 2. The coefficient of friction is 0.3 and the maximum pressure on the brake lining is 1 N/mm^2. The width of the block is equal to its length. Calculate (i) the actuating force (ii) the dimensions of the block (iii) the resultant hinge-pin reaction (iv) the rate of heat generated, if the brake drum rotates at 50 rpm.	[08]	CO1
	OR		
1 (c')	An automotive single plate clutch consists of two pairs of contacting surfaces. The outer diameter of the friction disk is 270 mm. The coefficient of friction is 0.3 and the maximum intensity of pressure is 0.3 N/mm2. The clutch is transmitting a torque of 531 N-m. Assuming uniform wear theory, determine (i) the inner diameter of the friction disc (ii) spring force required to keep the clutch engaged.	[08]	CO1

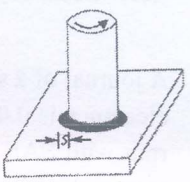


Figure 1

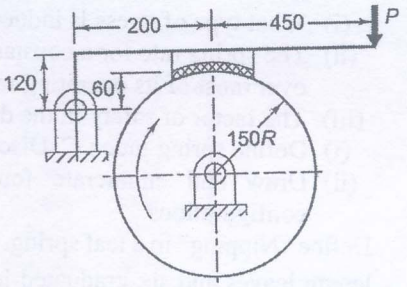


Figure 2

Contd....2.

2 (a) (i) The relationship between bearing life and reliability is given by a statistical curve known as ----------. [01×3] CO2

(ii) On what factors the value of C (Combined heat transfer coefficient) depends on?

(iii) Enumerate three advantages of cylindrical roller bearing over other rolling element bearings.

2 (b) (i) Draw and explain curve for bearing characteristic number vs. coefficient of friction. [02×2] CO2

(ii) In a particular application, the radial load acting on a ball bearing is 5 kN and the expected life for 90% of the bearings is 8000 hr. Calculate the dynamic load carrying capacity of the bearing, when the shaft rotates at 1500 rpm.

2 (c) A shaft transmitting 50 kW at 125 rpm from the gear G_1 to the gear G_2 (Fig. 3), and mounted on two single-row deep groove ball bearing B_1 and B_2. The gear tooth forces are P_{t1}= 15915 N, P_{r1}=5793 N, P_{t2}= 9549 N, P_{r2}= 3476 N. The diameter of the shaft at bearing B_1 and B_2 is 75 mm. The load factor is 1.4 and the expected life for 90% of the bearing is 10000 hours. Select suitable ball bearing. Refer Table 1. [08] CO2

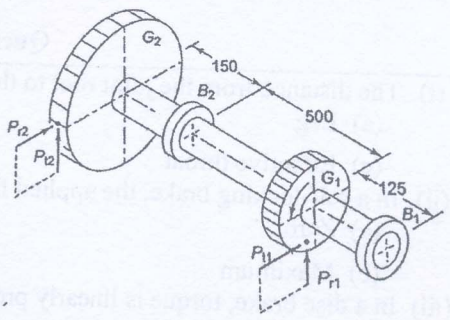


Figure 3 [All dim. in mm]

OR

2 (c') A journal of a stationary oil engine is 80 mm in diameter and 40 mm long. The radial clearance is 0.060mm. It supports a load of 10 kN when the shaft is rotating at 3500 rpm with SAE 40 oil supplied at atmospheric pressure. Assumed average operating temperature is about 60°C as first trial for inlet oil temperature of 45°C. Analyse the bearing temperature under steady state operating condition. [08] CO2

3 (a) (i) What type of stress is induced in helical torsion spring. [01×3] CO3

(ii) The spring rate for a constant-pitch helical compression spring is---------- over most of its operating range.

(iii) The factor of safety in the design of springs is usually 1.5 or less why?

3 (b) (i) Define spring index C. Discuss disadvantages of using $C<3$ and $C>15$. [02×2] CO3

(ii) Draw and enumerate four types of spring according to their physical configurations.

3 (c) Define "Nipping" in a leaf spring. A semi-elliptic leaf spring consists of two extra full-length leaves and six graduated-length leaves, including the master leaf. The centre-to-centre distance between the two eyes of the spring is 1 m. The maximum force acting on the spring is 10 kN and the width of each leaf is 50 mm. The spring is initially pre-loaded in such a way that when the load is maximum, the stresses induced in all the leaves are equal to 350N/mm^2. The modulus of elasticity of the leaf material is 208,000 N/mm^2. Design the spring and find: [08] CO3

(i) The thickness of leaves, and

(ii) The deflection of the spring at maximum load.

OR

3 (c') It is required to design a helical torsion spring for a window shade. The spring is made of patented and cold-drawn steel wire of Grade-4. The yield strength of the material is 60% of the ultimate tensile strength and the factor of safety is 2. From space considerations, the mean coil diameter is kept as 18 mm. The maximum bending [08] CO3

Contd....3.

moment acting on the spring is 250 N-mm. The modulus of elasticity of the spring material is 207 000 N/mm^2. The stiffness of the spring should be 3 N-mm/rad. Determine the wire diameter and the number of active coils. Take S_{ut}=2290N/mm^2.

4 (a) (i) How are circular and diametral pitches related to each other? [01×3] CO4

(ii) What is the difference between involute and cycloidal gear teeth?

(iii) Consider a spur gear having 4 mm of circular pitch and a pitch circle diameter of 28mm. Calculate the total number of teeth in the gear.

4 (b) (i) What are the differences in 14.5° & 20° full-depth involute teeth gears? [02×2] CO4

(ii) What are the advantages and disadvantages of involute teeth gears?

4 (c) It is required to design a pair of spur gears with 20° full-depth involute teeth consisting of a 20-teeth pinion meshing with a 50 teeth gear. The pinion shaft is connected to a 22.5 kW, 1450 rpm electric motor. The starting torque of the motor can be taken as 150% of the rated torque. The material for the pinion is plain carbon steel Fe 410 (S_{ut} = 410 N/mm^2), while the gear is made of grey cast iron FG 200 (S_{ut} =200 N/mm^2). The factor of safety is 1.5. Design the gears based on the Lewis equation and using velocity factor to account for the dynamic load. [08] CO4

OR

4 (c') What is meant by Lewis bending equation? How is it used in the design of gears? [08] CO4

A pair of spur gears consists of a 20 teeth pinion meshing with a 120 teeth gear. The module is 4 mm. Calculate

(a) the centre distances
(b) the pitch circle diameters of the pinion and the gear
(c) the addendum and dedendum
(d) Tooth thickness
(e) the gear ratio

Table 1

Principal dimensions (mm)			*Basic load ratings (N)*		*Designation*
d	*D*	*B*	*C*	C_o	
70	90	10	12100	9150	61814
	110	13	28100	19000	16014
	110	20	37700	24500	6014
	125	24	61800	37500	6214
	150	35	104000	63000	6314
	180	42	143000	104000	6414
75	95	10	12500	9800	61815
	115	13	28600	20000	10615
	115	20	39700	26000	6015
	130	25	66300	40500	6215
	160	37	112000	72000	6315
	190	45	153000	114000	6415

2023-24
B.TECH. (AUTUMN SEMESTER) EXAMINATION
(Mechanical Engineering)
Heat and Mass Transfer
(MEC3210)

Maximum Marks: 60 **Credits: 04** **Duration: Two Hours**

Attempt all questions. Assume any suitable data, if needed.
Symbols have their usual meanings.
Marks allotted to each question and course outcome (CO) covered are indicated against each question.

Q. No.	Question	CO	M. M.
1(a)	Using the general heat conduction equation in Cartesian coordinates, find the Poisson's equation.	CO1	1
1(b)	Whether heat transfer by conduction can take place in fluids? Explain.	CO1	1
1(c)	Write the value of thermal conductivity of one insulating material with its name.	CO1	1
1(d)	State under what conditions a plane wall can be considered as to have 1 D heat transfer and 2 D heat transfer.	CO1	2
1(e)	What is overall heat transfer coefficient? For a flat plate of thickness 5 cm and thermal conductivity 0.5 W/mK with fluids on both sides of the plate, having convective heat transfer coefficients of 10 W/m^2 K, find the overall heat transfer coefficient.	CO1	2
1(f)	What is critical thickness of insulation? Derive its expression and discuss its importance with reference to current carrying conductors and steam carrying pipes. Write the assumptions made.	CO1	8
	OR		
1'(f)	A long square rod of 10 mm side protrudes from a furnace at 170 °C into air at 30 °C. The thermal conductivity of the rod is 50 W/mK and the convective heat transfer coefficient of air is 30 W/m^2 K. Calculate the temperature at a distance 80 mm from the furnace wall and the location at which the temperature will be 80 °C. Derive the expression used.	CO1	8
2(a)	What do you mean by lumped heat capacity system?	CO2	1
2(b)	Define radiosity and irradiation.	CO2	1
2(c)	Show the distribution of monochromatic emissive power of black body over a wide range of wavelength for different temperatures.	CO2	1
2(d)	A low value of time constant is desirable. How it can be achieved for a thermocouple? What is the approximate value of time constant for thermocouples?	CO2	2
2(e)	Write the properties of glass due to which it is used as a cover in solar collector.	CO2	2
2(f)	Define radiation shape factor. Derive the relations for the radiation shape factor for (i) a small disc radiating with a large parallel disc, and (ii) a small disc fitted centrally at the cylinder cover and exchanging heat with the cylindrical surface. Write the assumptions made.	CO2	8
	OR		
2'(f)	A carbon steel rod, 0.2 m long and 0.06 m diameter, is quenched from 500 °C to 30 °C in a large reservoir of water at 10°C. Below 100°C, the heat transfer coefficient is 300 W/m^2 K and above 100°C, its effective mean value is 10 W/m^2 K. The thermo physical properties of carbon steel are $\rho = 7854$ kg/m^3, k = 50 W/mK, C = 559 J/kgK. Calculate the quenching time. Also find the Fourier and Biot numbers.	CO2	8

contd.... 2.

3(a)	Explain hydrodynamic and temperature boundary layers.	CO3	1
3(b)	Give significance of Re, Gr, Nu and Pr.	CO3	0.5x4
3(c)	For laminar boundary layer during free convection over a vertical plate, draw the velocity and temperature profiles and write the momentum and energy equations.	CO3	2
3(d)	Explain filmwise and dropwise condensation, highlighting their merits.	CO3	2
3(e)	With suitable assumptions and sketches, derive the relation for Nusselt Number in case of liquid metal flowing over a flat surface forming a laminar boundary layer.	CO3	8
	OR		
3'(e)	A liquid at 20°C flows over a flat plate at a velocity of 0.15 m/s. If the plate, 3m long and 1.5m wide, is heated uniformly and maintained at 100°C, calculate the following: (i) Velocity and thermal boundary layer thicknesses at trailing edge of the plate. (ii) Total drag force on one side of the plate. (iii) Local heat transfer coefficient at the trailing edge. (iv) Heat transfer rate. Thermo-physical properties of the liquid at 60°C are: $\rho = 956.8\ kg/m^3$, $k = 0.213\ W/mK$, $\alpha = 7.2 \times 10^{-8}\ m^2/s$, $\nu = 0.65 \times 10^{-4}\ m^2/s$	CO3	8
4(a)	Considering the fouling factors on the inner and outer surfaces of the tube in a double pipe heat exchanger, write the equation for overall heat transfer coefficient.	CO4	1
4(b)	Draw temperature profiles for the two fluids in a condenser and an evaporator.	CO4	1
4(c)	Briefly explain the diffusion mass transfer and convective mass transfer.	CO4	1
4(d)	With neat sketch show the cross flow heat exchanger and also draw variation in temperatures of the two fluids from one end to the other end.	CO4	2
4(e)	Show the concentration profile in the mass transfer boundary layer over a flat surface. Also, write the convective mass transfer equation.	CO4	2
4(f)	Derive expressions for effectiveness of a counter flow heat exchanger in terms of NTU and heat capacity ratio. Reduce the equation for condenser and evaporator.	CO4	8
	OR		
4'(f)	With suitable assumptions and neat diagram,obtain relation for Isothermal evaporation of water from a deep tank in the presence of stagnant air above the water level. In an open tank having 3m diameter, Benzene (M =78) forms a 1mm deep layer at the bottom and diffuses through a stagnant air film of 10 mm thickness. If the operating pressure and temperature of the system are one atmosphere and 25°C, while vapour pressure of benzene in the tank is 0.15 bar, calculate the time taken for the entire benzene to evaporate. Also find its mass transfer coefficient. For benzene take the density as 880 kg/m^3 and diffusivity as 8 x 10^{-6} m^2/s.	CO4	8

2023-24

B.TECH. (ODD SEMESTER) EXAMINATION

MECHANICAL

FLUID MECANICS – II

MEC3310/ME332

Maximum Marks: 60 **Credits: 03** **Duration: Two Hours**

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.
Use of Mathematical Formula Sheet is allowed.

Q.No.	Questions	CO	M.M.
1a.	i. What do you understand by constitutive relationship? Briefly explain. ii. What is Stokes' hypothesis?	CO1	[1+1]
1b.	After scaling and dimensional analysis: (i) Write down the transformed Non-Dimensional Navier-Stokes equations for incompressible, homogenous, Newtonian, Constant Property flow. (ii) Briefly explain the significance of the non-dimensional numbers occurring in the equation obtained in (i). (iii)For the limiting case of $Re \to 0$ and $Re \to \infty$, simplify the governing equations obtained in (i). Assume non-dimensional dynamic pressure defined as $\frac{p-p_o}{\mu U_s/L_s}$.	CO1	[2+2+2]
1c.	To study the flow of blood in an artery, the following assumptions can be made: • The artery can be assumed to be a circular pipe of length L, and radius R, with rigid walls. • A fully developed flow enters the artery at inlet. • Blood is assumed to be a Newtonian fluid with homogenous and constant properties. • The heart pumping action is assumed to be sinusoidal in nature. The flow velocity of the blood coming out of the heart can be assumed to be $\vec{V}(z,t) = A(r)\sin\omega t\,\hat{e}_z$. (i) Write the Navier-Stokes equations describing the flow behaviour. (ii) Write the initial and boundary conditions for the flow. (iii) Identify the various scaling parameters which can be used for writing the N-S equations in non-dimensional form. (iv) Simplify the equation for axial Uni-directional flow.	CO1	[7]

OR

contd....2

1c'. Consider a fluid filled inside a steadily rotating cylinder with velocity (ω). After a sufficient length of time, fluid would be in a state of solid body rotation. Using cylindrical coordinates such a velocity field may be written as $\vec{V} = v_\theta \hat{e}_\theta$ where $v_\theta = \omega r$. **CO1** [7]

(i) Obtain the vorticity vector
(ii) Particle acceleration
(iii) The strain rate tensor components
(iv) Volumetric Strain rates
(v) Viscous stress tensor

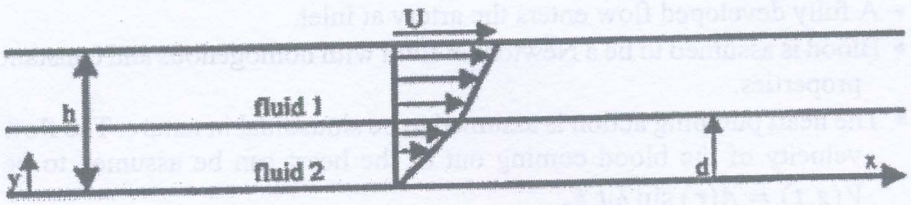
2a. In a Uni-directional viscous flow of a Newtonian fluid with straight streamlines in pipes or ducts, **CO2** [1+1+1]
State whether these statements are true or false.

i. $\frac{dp_m}{dx} < 0$.
ii. the motion pressure does not vary normal to the streamlines.
iii. convective acceleration is non-zero.

2b. Evaluate for Uni-directional flows in a wide channel, **CO2** [2+2]

i. $\nabla^2 \vec{V}$
ii. $(\vec{V}.\nabla)\vec{V}$

2c. Planar Couette flow is generated by placing a viscous fluid between two infinite parallel plates and moving one plate (the upper one) at a velocity U with respect to the other one. The plates are a distance h apart. Two immiscible viscous liquids are placed between the plates as shown in the diagram below. Solve for the velocity distributions in the two fluids. **CO2** [8]



3a. State whether the following statement is True or False: **CO3** [1x3=3]

(i) The maximum thickness of boundary layer in a pipe of radius 'r' is 'r'.
(ii) The separation of boundary layer takes place when the pressure gradient is adverse.
(iii) The wall shear stress at the point of separation is zero.

Contd....3.

3b. An incompressible fluid flow over a flat plate with zero pressure gradient. The boundary layer thickness is 1 mm at location where the Reynolds number is 1000. If the velocity of the fluid alone increased by a factor of 9, then: **CO3** [2+2]

(i) find the boundary layer thickness at the same location.

(ii) derive the relationship used to calculate the above boundary layer thickness.

3c. For a flow over a flat plate with zero pressure gradient, the velocity profile within the boundary layer is assumed as $u(x,y) = U_\infty (A + B\eta + C\eta^2 + D\eta^3)$ where $\eta = \frac{y}{\delta(x)}$. Show that the skin friction on the plate is given by $\frac{\tau_w}{\rho U_\infty^2} = 0.3232 \left[\frac{U_\infty x}{\upsilon}\right]^{-\frac{1}{2}}$. **CO3** [8]

OR

3c'. Water with a uniform free stream velocity of 1m/s flows past a flat plate of length L=20cm. Find the thickness of the velocity boundary layer at a location x = 10cm. At the same location, find the fluid velocity at a distance y = 0.0225cm away from the surface. Calculate drag on the plate per meter depth into the plane of the paper. For water $\rho = 983.1$ kg/m^3, $\upsilon = 0.4748 \times 10^{-6}$ m^2/s. **CO3** [8]

$\eta = y/\sqrt{\frac{\nu x}{U_\infty}}$	f	$f'(\eta) = \frac{u}{U_\infty}$	$f''(\eta)$
0	0	0	0.33206
1.2	0.23795	0.39378	0.31659
2.0	0.65003	0.62977	0.26675
5.0	3.28329	0.99155	0.01591

4a. State weather following statements are True or False. **CO4** [1×5]

i. Turbulent boundary layer is thicker than laminar boundary layer.

ii. Vertical Momentum transfer is absent in turbulent boundary layer.

iii. $u^+ = y^+$ gives the velocity profile in viscous sub-layer.

iv. $u^+ = A\ln(y^+) + B$ is called the Universal Law of the wall for turbulent flows.

v. $\frac{U_{max} - \langle u \rangle}{U_\tau} = \frac{1}{\kappa}\ln\left(\frac{h}{y}\right)$ is known as the Velocity Defect law.

4b. Derive Reynolds Averaged Navier-Stokes Equation. **CO4** **[10]**

OR

4b'. Discuss in detail Prandtl's mixing length model. **CO4** **[10]**

2023-24

B. TECH. (AUTUMN SEMESTER) EXAMINATION

MECHANICAL ENGINEERING

INDUSTRIAL ENGINEERING

MEC 3410

Maximum Marks: 60 **Credits: 04** **Duration: Two Hours**

Note:

(i) Attempt all questions. Assume any suitable data, if needed.

(ii) Symbols have their usual meanings.

(iii) Marks allotted to each question and course outcome (CO) covered are indicated against each question.

Q. No.		Question	CO	M. M.
1(a)		Attempt **any three** of the followings:		1x3
	(i)	Units of output per labor hour is known -------- productivity.	1	
	(ii)	Intangible nature of many service elements makes it hard to measure ------ productivity.	1	
	(iii)	The layout in which the arrangement of machines and equipment is done as per the sequence of operations is known as --------.	2	
	(iv)	In ------ the interpretation of each successive symbol is dependent on the preceding symbols,	1	
	(v)	The product liability which is caused due to producer's lack of proper care which makes a product unsafe is known as --------.	1	
	(vi)	Sum of production times in an assembly line is known as --------.	2	
1(b)		Attempt **any two** questions:		2x2
	(i)	Name the four stages of product life cycle.	1	
	(ii)	Why the product development process is complex?	1	
	(iii)	What is a market based criteria for success?	2	
	(iv)	Classify Flexible manufacturing systems on the basis of level of flexibility.	2	

Contd....2

1(c) The MS 800 car is to be assembled on a conveyor belt. Five hundred cars are required per day. Production time per day is 420 minutes, and the assembly steps and times for the car are given below. Find the balance that minimizes the number of workstations, subject to cycle time and precedence constraints. 2 8

Task	Task time (seconds)	Description	Tasks that must precede
A	45	Position & fasten rear axle	-
B	11	Four screws to nuts	A
C	9	Insert rear axle	B
D	50	Tighten screws	-
E	15	Position front axle	D
F	12	Fasten screws to nuts	C
G	12	Tighten front axle screws	C
H	12	Position & fasten rear wheel 1	E
I	12	Position & fasten rear wheel 2	E
J	8	Position & fasten front wheel 1	F, G, H, I
K	9	Position & fasten front wheel 2	J

(i) Draw a precedence diagram.

(ii) Determine workstation cycle time.

(iii) Determine the theoretical minimum number of workstations required.

(iv) Make task assignments to form workstations.

2(a)

(i) Slack is the length of time an activity can be ------ without ----- the entire project. 2 1

(ii) A process that is operating in presence of ------- is said to be out of control. 5 1

(iii) In value engineering a logic diagram to define the working of a system is known as ---- ------ diagram. 5 1

2(b)

(i) In the context of quality, differentiate between internal and external failure costs. 5 2

(ii) What is a Liquid Penetrant Inspection? 5 2

Contd....3.

2(c) A product manager has planned a list of activities culminating in the inaugurate launch of the new products. These are given in the table below: 5 8

Activity	pert 3 time estimates(days)			Immediate Predecessor (s)
	P	M	O	
a	20	10	5	–
b	12	7	5	–
c	12	10	8	a
d	40	20	6	c
e	90	60	30	d
f	14	10	7	d
g	50	30	20	c
h	12	10	8	e, f, g
i	6	4	3	b
j	1	1	1	h,i

Using forward pass method, determine the critical path and expected project duration. What is the probability that product manager will be able to complete the language launch within 80 days-time?

STANDARD NORMAL DISTRIBUTION:

Table Values Represent AREA to the LEFT of the Z score.

Z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
-2.8	.00256	.00248	.00240	.00233	.00226	.00219	.00212	.00205	.00199	.00193
-2.7	.00347	.00336	.00326	.00317	.00307	.00298	.00289	.00280	.00272	.00264
-2.6	.00466	.00453	.00440	.00427	.00415	.00402	.00391	.00379	.00368	.00357

OR

2'(c) What do you understand by Quality Function Deployment? The data for defects in 15 samples of a product is presented below: 5 8

Sample number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
No. of defects	12	8	13	14	21	10	7	14	10	12	13	4	12	27	13

Determine upper and lower control limits and draw an appropriate control chart. Is the process under statistical control?

Contd...4.

3(a)				
	(i)	Type of capacity planning associated with Master Production Schedule is.....	3	1
	(ii)	Number of chance events in case of no expansion alternative in decision tree analysis	3	1
	(iii)	Condition for managing a queue in terms of arrival and service rates is.....	4	1
3(b)	(i)	Describe briefly, the re-order point concept in a deterministic inventory control environment.	4	2
	(ii)	Explain the basic structure of a non-linear programming model.	5	2
3(c)		Describe any three wastes identified through Just-in-Time (JIT) technique. Explain using numerical example, the development of an appropriate aggregate production plan.	4	8

OR

3'(c)		Discuss any two Q/R systems used to describe an inventory control situation. ABC Company purchases 22000 units of a certain component annually. A fixed ordering cost of $ 55 is incurred every time an order is placed. The transportation of the component from the supplier to the company is done by a vehicle that charges $110 for every trip and can accommodate a maximum of 1000 units in one trip. The transportation cost is borne by the company. The holding cost is estimated to be $ 5.5 per unit per year. The unit purchase price is $ 8.5. However, if order is placed for more than 1000 units the unit purchase price is $ 8.25. Find the EOQ (Economic Order Quantity) and the total cost with the obtained value of EOQ.	4	8
4(a)				
	(i)	Number of D.C. Little relations used in queuing systems.....	4	1
	(ii)	The two main aspects of work study are.....	3	1
	(iii)	North-West allocation method is used to solve..... problems.	4	1
4(b)				
	(i)	Describe using numerical example, the development of a Material Requirement Planning (MRP) schedule.	3	2
	(ii)	Explain the birth and death process used to develop various queuing models.	4	2

Contd...5.

4(c) Describe the basic structure of a queuing system. Select an error tolerance to perform only three iterations, for the solution through GSP of the following multi-variable non-linear unconstrained programming problem: 5 8

$$\text{Maximize } f(X) = 4X_1 + 2X_2 + X_1^2 - X_1^4 - 2X_1X_2 - X_2^2$$

OR

4'(c) Write few lines regarding practical applications of linear programming approach in an automated manufacturing industry? Determine optimal solution for the following transportation problem. The matrix entries are cost of transporting one unit from factory to store. 5 8

		Store				Supply
		1	2	3	4	
Factory	1	10	12	15	22	8
	2	9	10	13	21	9
	3	18	20	23	29	14
	4	26	25	29	36	23
Requirement		20	10	12	12	54/54

END